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Sanitary Department—Glasgow.

REPORT

ON THE

AIR OF GLASGOW,



WITH TABLES OF WIND, TEMPERATURE, AND RAIN-FALL,
FOR THE MONTH OF AUGUST. 1877.

BY

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IN CO-OPERATION WITH THE MEDICAL OFFICER OF HEALTH.

*PRESENTED TO THE COMMITTEE OF HEALTH OF THE MAGISTRATES AND
COUNCIL OF GLASGOW, 19th NOVEMBER, 1877.*

GLASGOW:

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EXPLANATORY REMARKS.

The accompanying Tables fall under two classes, one of them containing the Tables which state the average amounts of certain substances existing in 100 cubic feet of air at the places and during the times specified, and the other containing Tables explanatory of the former, and referring either to the results of special investigations or to meteorological conditions existing during the times and at the places in question.

Regarding the results of analysis contained in the Tables of the first class, it is sufficient to state here that at each of the stations therein mentioned the air is drawn by aspiration, and continuously for two or three days in several distinct currents through as many distinct solutions, each of which is adapted to withdraw a special substance from the current of air which passes through it; that the amount of air which passes in each current is measured by means of a special gas meter, through which that current subsequently passes; and that the amount of the substance which is specially absorbed from each of the air currents is finally determined by a method sufficiently delicate for the estimation of quantities that in most cases would be called "traces."*

The object of the Tables of the second class is, as already stated, to supply all the information that may be available, or that may appear to be necessary, for correctly interpreting the analytical results in the Tables of the first class. The portion of these Tables relating to changes in the direction and velocity of the wind, and also that relating to the average temperature during the days to which each of the analytical results refers, will continue to be supplied by Professor Grant of the Glasgow Observatory, from the results obtained there by self-recording apparatus. As regards rain-fall, however, it has been arranged, in consequence of its marked effect upon the results hitherto obtained, that, from August 1, regular observations of rain-fall shall be made at each of the Stations for air-analysis, and that analysis of the rain falling in the open country, and at two or more points in the City, shall also be regularly made.

The Tables of the first class are numbered, and show the results obtained with respect to the following substances, viz. :—

Table I.—Carbonic Acid.

„ II.—Sulphur in combination.

„ III.—Chlorine free and combined.

„ IV.—Nitrogen in the form of Ammonia.

„ V.—Nitrogen in the form of "Albumenoid Ammonia."

* It is intended to publish, as early as possible, a detailed account of the mechanical and chemical processes whereby these results are obtained. Meanwhile, it may be interesting to state that, since the idea of employing a gas meter for measuring the amount of air submitted to examination occurred to me, I have found that in 1848 the late Dr. Dundas Thomson, of Glasgow University, employed the same means for that purpose in his attempt to estimate the amount of ammonia in the air of a crowded part of the city during the cholera epidemic which then prevailed.

Unless the opposite is expressly mentioned, all the numerical and other statements in the Tables must be understood to refer, not exclusively to the day indicated by the corresponding date, but to the interval between noon of that day and noon of the day indicated by the date immediately preceding.

The amounts of the various substances estimated in 100 cubic feet of air are in all cases, except that of carbonic acid, expressed in units of weight. The unit employed is the milligramme. In the case of carbonic acid the usual method of expressing the amount as so many volumes in 10,000 volumes of air has been followed.

The "dashes" in the Tables indicate experiments lost through known causes. The "marks of interrogation," on the other hand, indicate results departing so far from the normal character as to be clearly erroneous, while it is impossible to state with certainty the cause of error.

Rain-fall is expressed in inches, the velocity of the wind in miles per hour, and temperature in Fahrenheit degrees.

The accompanying Map of Glasgow will, it is hoped, also contribute materially to the interpretation of the results of analysis. In it the relative density of shading corresponds approximately with the density of the population, and the black patches indicate the sites of manufacturing establishments, from which proceed large quantities of smoke or of noxious vapours. The positions of the Stations referred to in the Tables are indicated upon the Map by special marks, and the localities in which these Stations are situated are named below. These names are employed in the Tables to designate the respective Stations.

With respect to the Eaglesham Station, which will appear in these Tables from August 1, it is to be explained that it is situated at a distance of about 3 miles to the south of the village of that name, and about 12 miles in the same direction from Glasgow. It stands at an altitude of 997·5 feet above sea-level, upon the northern slope of the extended range of trap hills which forms to some extent a boundary to the counties of Ayr, Renfrew, and Lanark. The locality is so remote from manufacturing and even agricultural operations that the air and rain to be obtained there may be fairly accepted as standards wherewith to compare the air and rain of Glasgow. It will also be used for some special investigations regarding ozone and other constituents of the atmosphere.*

GLASGOW, 25th July, 1877.

* 14th November, 1877.—Owing to the position necessarily chosen for this Station, which is with difficulty accessible except in good weather, the arrangements were considerably delayed by the rains of the past summer and autumn, and though these are now complete, the season is too far advanced to permit of the apparatus being used before the end of next spring, when the temperature at that altitude shall have risen so as to allow of the continuous use of the water, on the flow of which the working of the apparatus depends.



- ⊙ Indicates Station in Stirling Square.
 ⊕ " " in Calton.
 ○ " " at Sailors' Home.
 ⊕ Indicates Station in Cowcaddens.
- ⊙ Indicates Station at Hospital, Kennedy Street.
 ⊕ " " under arch of Broomielaw Bridge.
 ⊙ " " at Western Infirmary.

TABLE I.—Carbonic Acid.

DATE.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
<i>N.B.</i> —The Carbonic Acid results are withheld pending the conclusion of experiments on a more accurate and easy method of analysis, also permitting the manipulation of larger volumes of air.						
AVERAGE,.....						

TABLE II.—Sulphur in combination.

DATE.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
August 1,.....						
„ 3,.....	—	—	—	—	—	—
„ 6,.....	0·18	0·14	0·25	0·31	0·43	0·12
„ 8,.....	0·18	0·37	0·25	0·30	0·32	0·14
„ 10,.....	0·15	—	0·26	0·10	0·26	0·21
„ 13,.....	0·17	0·18	0·54	0·18	0·15	0·12
„ 15,.....	0·10	0·24	0·46	0·10	0·11	0·24
„ 17,.....	0·34	0·33	0·15	0·33	0·34	0·26
„ 20,.....	0·10	0·15	0·91	0·09	—	0·02
„ 22,.....	0·19	0·32	0·39	—	0·20	0·04
„ 24,.....	0·24	0·30	0·25	0·25	0·27	0·06
„ 27,.....	0·19	0·33	0·40	0·22	0·27	0·24
„ 29,.....	0·29	0·30	0·34	0·16	0·27	0·12
„ 31,.....	0·20	0·30	0·06	5·14	0·17	0·04
AVERAGE,.....	0·20	0·27	0·36	0·20	0·25	0·13

TABLE III.—Chlorine free and combined.

DATE.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
August 1,.....						
„ 3,.....	—	—	—	—	—	—
„ 6,.....	0·00	0·00	0·20	0·00	0·06	0·00
„ 8,.....	0·13	0·14	0·55	0·11	0·11	0·11
„ 10,.....	0·15	0·08	1·85	0·07	0·09	0·00
„ 13,.....	0·03	0·00	0·54	0·00	0·00	0·00
„ 15,.....	0·06	0·07	1·18	0·08	0·07	0·13
„ 17,.....	0·15	0·09	0·14	0·13	0·09	—
„ 20,.....	0·07	?	0·85	0·08	0·17	0·10
„ 22,.....	0·28	0·00	0·94	0·08	—	0·06
„ 24,.....	0·00	0·00	0·04	0·00	0·13	0·00
„ 27,.....	0·09	0·05	0·25	0·06	?	0·12
„ 29,.....	0·07	0·10	0·23	0·01	0·05	0·02
„ 31,.....	0·09	0·08	0·10	0·02	0·09	0·07
AVERAGE,.....	0·09	0·06	0·57	0·05	0·09	0·06

TABLE IV.—Nitrogen in the form of Ammonia.

DATE.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
August 1,.....						
„ 3,.....	—	—	—	—	—	—
„ 6,.....	·131	·101	·044	·100	·078	·104
„ 8,.....	·131	·174	·073	·098	·160	·038
„ 10,.....	·168	·117	·036	·054	·033	·048
„ 13,.....	·070	·066	·015	·070	·041	·038
„ 15,.....	·187	·098	·180	·111	·038	·004
„ 17,.....	·117	·087	·063	·121	·095	·057
„ 20,.....	·161	·183	·021	·046	·054	·008
„ 22,.....	?	·081	·041	·055	—	·039
„ 24,.....	·091	·110	·022	·077	·092	·036
„ 27,.....	·540	·055	·034	?	·026	·037
„ 29,.....	·195	·223	·037	·083	·094	·096
„ 31,.....	·351	·171	·042	·054	·025	·048
AVERAGE,.....	·195	·122	·051	·079	·067	·046

TABLE V.—Nitrogen in the form of “Albumenoid Ammonia.”

DATE.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
August 1,.....						
„ 3,.....	—	—	—	—	—	—
„ 6,.....	·162	·206	·177	·114	·150	·187
„ 8,.....	·074	·098	·077	·063	·065	·076
„ 10,.....	·086	·054	·076	·117	·040	·086
„ 13,.....	·100	·197	·214	·058	·136	·077
„ 15,.....	·120	·087	·298	·107	·038	·122
„ 17,.....	·059	·040	·059	·041	·071	·033
„ 20,.....	·122	·171	·048	—	·066	·038
„ 22,.....	·153	·063	·041	·052	—	·026
„ 24,.....	·050	·110	·033	·086	·051	·044
„ 27,.....	·082	·026	·045	?	·035	·064
„ 29,.....	·140	·081	·054	·100	·083	·068
„ 31,.....	·066	·062	·023	·041	·038	·053
AVERAGE,.....	·101	·100	·095	·078	·070	·073

Rain-fall and Average Temperature during each of the Intervals referred to in the Tables for July and August.

JULY.			AUGUST.		
	TOT. RAIN.	AV. TEMP.		TOT. RAIN.	AV. TEMP.
2nd,.....	·05	58°15	6th,.....	·32	56°89
4th,.....	·21	52°37	8th,.....	·43	61°42
6th,.....	·26	53°87	10th,.....	·35	59°87
9th,.....	·39	55°81	13th,.....	·01	58°56
11th,.....	·10	56°87	15th,.....	·01	63°40
13th,.....	·30	55°25	17th,.....	·07	62°13
16th,.....	1·00	57°78	20th,.....	2·87	53°47
18th,.....	·01	57°90	22nd,.....	·42	53°40
20th,.....	·21	56°29	24th,.....	·15	53°09
23rd,*.....	·44	57°89	27th,.....	·28	53°87
			29th,.....	1·10	55°40
			31st,.....	·89	54°70

* Investigation intermitted until 3rd August, during Assistant's holiday.

Summary of Averages for the Months of May, June, July, and August.

SUBSTANCE ESTIMATED.	MONTH.	STIRLING SQUARE.	CALTON.	HOSPITAL, KENNEDY ST.	SAILORS' HOME.	BROOMIELAW BRIDGE.	WESTERN INFIRMARY.
Sulphur in combination,	May,	·26	·36	·42	·28	·29	·14
	June,	·19	·23	·26	17	—	·09
	July,	·18	·22	·16	·14	·14	·07
	August,	·20	·27	·36	·20	·25	·13
Chlorine free and combined,	May,	·09	·08	·63	·05	·05	·06
	June,	·07	·08	·51	·05	—	·05
	July,	·08	·11	·17	·06	·09	·09
	August,	·09	·06	·57	·05	·09	·06
Nitrogen as Ammonia,	May,	·052	·067	·033	·046	·038	·016
	June,	·053	·076	·019	·038	—	·012
	July,	·191	·128	·040	·053	—	·031
	August,	·195	·122	·051	·079	·067	·046
Nitrogen as Albumenoid Ammonia,	May,	·075	·081	·064	·057	·050	·044
	June,	·088	·096	·082	·061	—	·054
	July,	·081	·067	·064	·074	—	·067
	August,	·101	·100	·095	·078	·070	·073
Organic Matter, as represented by Nitrogen in both the above Forms,	May,	·127	·148	·097	·103	·088	·060
	June,	·141	·172	·101	·099	—	·066
	July,	·272	·195	·104	·127	—	·098
	August,	·296	·222	·146	·157	·137	·119

TABLE showing in detail the variations in the velocity and direction of the Wind during the month of August, 1877.

N.B.—The entries in the three last columns refer to the time between the corresponding dates and those immediately before them.

DATE.					AVERAGE DIRECTION OF WIND.	AVERAGE VELOCITY OF WIND.	DURATION OF WIND.	
Day.	Date.	Hours.	Minutes.				Hours.	Minutes.
Wednesday,	1	0	0	A. M.				
"	"	3	40	A. M.	W.	8.5	3	40
"	"	5	0	A. M.	S.S.W.	4	1	20
"	"	10	30	P. M.	W.	13.5	17	30
Thursday,	2	7	0	A. M.	W.S.W.	10	8	30
Friday,	3	6	30	P. M.	W.	15	35	30
"	"	11	0	P. M.	N.N.W.	4	4	30
"	"	12	0	Midnight.	W.	3	1	0
Saturday,	4	9	30	A. M.	N.N.W.	2.5	9	30
Sunday,	5	11	0	A. M.	S.W.	6.5	25	30
"	"	8	10	P. M.	N.E.	7	9	10
Monday,	6	1	10	P. M.	E.	8	17	0
"	"	5	0	P. M.	S.	10	3	50
"	"	7	45	P. M.	E.N.E.	8	2	45
Tuesday,	7	1	0	A. M.	S.E.	8	5	15
"	"	12	40	P. M.	E.	10	11	40
"	"	10	10	P. M.	S.E.	9	9	30
Wednesday,	8	9	45	A. M.	S.S.W.	4	11	35
"	"	6	45	P. M.	S.E.	9.5	9	0
Thursday,	9	10	40	A. M.	E.N.E.	9.3	15	55
"	"	7	0	P. M.	W.	8.4	8	20
Saturday,	11	10	30	A. M.	W.S.W.	9.5	39	30
"	"	1	50	P. M.	N.N.E.	5.5	3	30
Monday,	13	1	0	A. M.	E.	8	35	10
Tuesday,	14	10	30	P. M.	E.N.E.	17.5	45	30
Wednesday,	15	2	0	P. M.	E.	7.8	15	30
"	"	9	20	P. M.	E.N.E.	4	7	20
Thursday,	16	10	30	A. M.	N.W.	2	13	10
"	"	2	45	P. M.	W.	9.5	4	15
Friday,	17	1	30	P. M.	S.W.	4	22	45
"	"	2	30	P. M.	S.E.	6.5	1	0
Sunday,	19	3	0	A. M.	E.N.E.	16.5	36	30

DATE.					AVERAGE DIRECTION OF WIND.	AVERAGE VELOCITY OF WIND.	DURATION OF WIND.	
Day.	Date.	Hours.	Minutes.				Hours.	Minutes.
Sunday.....	19	8	0	A.M.	N.E.	22	5	0
Tuesday,	21	2	0	A.M.	E.N.E.	23	42	0
"	"	1	25	P.M.	N.E.	16	11	25
"	"	5	0	P.M.	N.W.	6	3	35
"	"	10	30	P.M.	N.	4	5	30
Wednesday,	22	9	20	A.M.	N.N.E.	4.5	10	50
"	"	2	40	P.M.	N.	7	5	20
"	"	6	0	P.M.	W.N.W.	7	3	20
"	"	7	25	P.M.	N.E.	4.5	1	25
"	"	10	25	P.M.	W.	3.5	3	0
Thursday,	23	3	0	A.M.	N.N.E.	2	4	35
"	"	4	10	A.M.	N.W.	3	1	10
"	"	10	15	P.M.	W.	6	6	5
Friday,	24	8	40	A.M.	S.W.	10	10	25
"	"	10	30	A.M.	W.S.W.	3	1	50
"	"	1	30	P.M.	S.W.	4	3	0
"	"	10	0	P.M.	W.S.W.	8	8	30
Saturday,	25	4	0	A.M.	S.S.W.	7	6	0
"	"	8	30	P.M.	E.N.E.	15	16	30
Sunday,	26	3	30	P.M.	N.E.	10.5	19	0
"	"	12	0	Midnight.	E.	6	8	30
Tuesday,	28	0	50	A.M.	E.N.E.	11	24	50
"	"	12	10	P.M.	S.W.	13.8	11	20
"	"	3	50	P.M.	N.W.	2	3	40
"	"	10	30	P.M.	E.N.E.	7	6	40
Wednesday,	29	2	0	A.M.	S.S.W.	3.5	3	30
"	"	4	0	A.M.	W.	2	2	0
"	"	6	10	A.M.	N.W.	2	2	10
"	"	3	40	P.M.	S.W.	12	9	30
"	"	7	0	P.M.	S.S.W.	13	3	20
"	"	12	0	Midnight.	S.	12.5	5	0
Thursday,	30	5	20	A.M.	S.S.W.	9	5	20
"	"	3	0	P.M.	W.S.W.	16	9	40
Friday,	31	4	15	A.M.	S.W.	12	13	15
"	"	6	35	A.M.	S.S.W.	5.5	2	20
"	"	12	0	Midnight.	W.N.W.	10.5	17	25

NOTES.

An examination of the fluctuations presented in the foregoing Tables, especially with respect to Sulphur, Chlorine, and Nitrogen in the forms of Ammonia and of "Albumenoid Ammonia" respectively, shows, amongst other things:—

- (1.) That the general character of the air prevailing in any part of the City can only be ascertained by means of observations carried on continuously, for some time, under the varying circumstances of weather.
- (2.) That the effect of a fresh breeze of wind in the way of purifying the air of the City is very marked.
- (3.) That the circumstances connected with the fall of rain appear to merit careful examination.
- (4.) That a rise in the Nitrogenous matters contained in the air takes place during the Summer months.